2. CONTRIBUTIONS TO OUR KNOWLEDGE OF WEST AUSTRALIAN POISON PLANTS,

Series i.,

BY

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It is proposed in this first contribution to indicate briefly details and results of some of the feeding tests carried out with W.A. poison plants, during the period from 1925 up to the present date.

1. Purpose of Experiments.

(1) To obtain knowledge of toxicity of plants under review at different stages of growth, this, in some instances, in response to applications from members of the public.

(2) To obtain knowledge as to type of symptoms and pathological changes induced by various species of plants, thereby filling up gaps in our present knowledge as well as giving indications for chemical investigations should such be undertaken.

(3) To test the action of antidotes, recommended, on the toxic properties of plants representative of the genera *Gastrolobium* and *Oxylobium*. These two genera contain the bulk of the Western Australian poison plants.

2. Technique.

(1) *Plant Material.*—Material, obtained in as fresh a state as possible, has often been received from stock owners, and at other times collected in response to request. As many different stages of growth as were obtainable have been tested, viz., seedlings, suckers, adult non-flowering and flowering and fruiting plants. Identifications have been made in each case by the Economic Botanist of the Department of Agriculture.

(2) *Dose and Method of Administration.*—The majority of the plants under review are said to be very highly toxic, as evidenced by experience in the field, acute symptons being produced with small quantities. The harsh nature of the plants is usually such that only small quantities would be likely to be eaten by stock except perhaps in the flowering stage. Hence the doses administered to experimental animals have usually been relatively small. The size of dose has also been influenced by the fact that supplies of plants have in most instances not been accessible close to Perth and it has not been considered advisable to test plants except when quite fresh. This has meant that duration of feeding tests has not exceeded more than a few days. The mode of administration has almost invariably been voluntary ingestion. Sometimes starving of experimental subjects had to be resorted to before feeds containing plants to be tested would be eaten. The idea of drenching plant preparations is not favoured.

(3) *Experimental Animals.*—In the absence of facilities for the housing and handling of larger animals, guinea pigs and wild rabbits have been mainly used as experimental subjects. The rabbit would appear to be more satisfactory for differentiation of symptoms than the guinea pig, though both are very susceptible to the action of poison plants.

It may be a fallacy to draw conclusions from the results of feeding tests on laboratory animals and apply them to stock generally, but in most instances the information obtained by laboratory tests appeared to correspond with field observations of the effects of the plants in question.

(4) *Working Methods.*—The same methods have been followed throughout the course of these experiments, so that it will save repetition if these are given at this stage.

In the cases where the plants appeared palatable they were fed alone without prior preparation, but as in most instances the plants tested were of hard fibrous nature, portions of the plant used were fed in finely divided condition, either minced or chopped, or, as in the case of seeds, pulverised in a mortar.

A weighed quantity of the prepared plant was well mixed with a known quantity (usually 10–15 grams) of bran or chaff and moistened with water. The feed was weighed both dry and wet, and fed. The residue not eaten by the animal was weighed wet and the weight of the plant eaten was calculated.

Feeds were, as a rule, administered twice daily, morning and evening.

Symptoms were noted where possible and post mortem examinations were conducted, obviously pathological tissues being subjected to microscopic examination.

3. Present Knowledge.

An excellent symposium on our present knowledge is contained in a monograph :—" The Poison Plants of Western Australia " (Revised Edition 1926, Bull. No. 96, Dept. of Agriculture, W.A.). This publication has proved a valuable guide to the present investigations.

SECTION A.—TOXICITY EXPERIMENTS—POSITIVE.

Oxylobium parviflorum, Benth. " Box Poison."

History.—This is one of the best known native poison plants and has a very bad reputation. It is considered to be most dangerous when flowering or fruiting. It is also toxic in the seedling stage. A toxic alkaloid " lobine " was isolated by Mann and Ince from this plant.

Experiment No. 1 :

(1) Source specimens—Economic Botanist.

(2) Nature specimens—Seeds.

(3) Date collected—December, 1924 ; Tested 2–2–26.

(4) *Details*—Guinea pig No. 1 showed symptoms 18 hours after eating 0·1 grams seed, and was found dead 24 hours later. Guinea pig No. 2 was found dead 18 hours after being fed, 0·07 grams being eaten.

(5) *Symptoms.*—Dullness, loss of control of hind limbs, later clonic spasms were apparent, followed by coma.

(6) *Post mortem.*—In both cases congestion—microscopically well marked congestion of liver, kidneys, and lungs.

Experiment No. 2 :

(1) Locality specimens—East Beverley.

(2) Nature specimens—Old plant, dying off.

(3) Date received—14–4–26 ; Tested 14–4–26.

(4) *Details.*—A sheep was given four ounces per day for six days, most of which was eaten, and showed symptoms on seventh day. The animal was dull and on " shaking up " exhibited inco-ordination of gait. For next few days the sheep would eat no feed containing box leaves and during this period gait was described by attendant as being " stiff." The sheep recovered on the third day.

Experiment No. 3 :

(1) Source specimens—Economic Botanist.

(2) Nature specimens—Seeds.

(3) Date collected—December, 1924 ; Tested 1–2–27.

(4) *Details.*—Five rabbits and nine guinea pigs succumbed to the effects of eating seeds in the course of experiments, the details of which are given later.

(5) *Symptoms.*—In the case of rabbits there was always conclusive evidence of convulsions prior to death, though none were actually seen at this stage.

Guinea pigs showed symptoms as described for Experiment No. 1. They do not, apparently, become affected with convulsions to the same extent as rabbits.

(6) *Post mortem*—Lesions as described for Experiment No. 1.

General Conclusions.—Seeds of *O. parviflorum* are very highly and constantly toxic for laboratory animals, rabbits being affected with convulsions prior to death.

Oxylobium tetragonophyllum, E. Priztel.

History.—A suspected plant not previously known to be toxic.

Experiment :

(1) Locality specimens—Ravensthorpe.

(2) Nature specimens—Fresh flowering plant.

(3) Received 27–8–26 ; Tested 30–8–26 and 6–9–26.

(4) *Details.*—During my temporary absence feeding experiments were carried out with this plant by J. Filmer, Veterinary Officer, Fremantle, and he has kindly made his results available for publication. On 30–8–26 a guinea pig and a rabbit were fed with mixed flowers, leaves and buds. Both animals succumbed, 3·4 grams of plant having been eaten by the guinea pig and 3·5 grams by the rabbit. On 6–9–26 another rabbit was fed with flowers and buds (which had previously been soaked for 5 hours in a 1% aqueous solution of potassium permanganate) with fatal result, the animal having eaten 4·0 grams of plant.

(5) *Symptoms.*—Hypersensitiveness to external stimuli, and convulsions followed by death.

(6) *Post mortem.*—Congestion, particularly of liver, and in one case (guinea pig) kidneys showed small haemorrhages in the cortex.

(7) *Conclusions.*—" The flowers and buds of *O. tetragonophyllum* are very toxic. They are apparently only slightly irritant but have a pronounced nervous stimulant effect." The toxic effect was still apparently undiminished nine days after plant received. " This plant when in the flowering stage is likely to prove toxic for some time after grubbing."

Gompholobium marginatum, R. Br.

History.—A suspected poison plant—no confirmatory evidence available.

Experiment :

(1) Locality specimens—Coolup.

(2) Nature specimens—Fresh fruiting plants.

(3) Date received—29–9–25 ; Tested 29–9–25.

(4) *Details.*—Guinea pigs were fed solely on the plant. Guinea pig No. 1 ate 50 grams and was found dead 42 hours after first feed. Guinea pig No. 2 ate 130 grams in 65 hours and appeared dull but recovered. A wild rat was daily given small amounts, and was found dead five days after first feed.

(5) *Post mortem.*—Congestion ; microscopically, kidneys, liver, and lungs showed congestion and haemorrhage.

(6) *Conclusion.*—*Gompholobium marginatum* appears to be toxic for small animals, in fruiting stage, when relatively large amounts are eaten. Further experiments are indicated.

Gastrolobium bidens, Meissn. "Kite Leaf Poison."

History.—This plant is known to be toxic in flowering and fruiting stages. Symptoms and post mortem appearance unknown. Correspondent providing specimens states the plant to be highly toxic for sheep in the seedling and sucker stages.

Experiment No. 1 :

(1) Locality specimens—Latham.

(2) Nature specimens—(a) Seedlings ; (b) Suckers ; (c) Adult plants bearing fruit pods not yet fully grown. All samples appeared quite fresh on arrival.

(3) Date collected—25-9-26 ; received—28-9-26.

(4) *Details* :—

Experimental Animal.	Feed.	Date.	Amount.	Plant Eaten.	Result.
			days.	Total.	
Sheep No. 1 ...	Whole Seedlings and Chaff	28-9-26 29-9-26	19 37	56	Negative.
Sheep No. 2 ...	Whole Suckers and Chaff	28-9-26 29-9-26 30-9-26	20 40 40	100	Negative.
Sheepo No. 4 ...	Fruiting Plant and Chaff	28-9-26 29-9-26 30-9-26 1-10-26	... 115 80 25	220	Negative.
Rabbit No. 4 ...	Seedlings only	28-9-26 29-9-26	5 10	15	Negative.
Rabbit No. 5 ...	Suckers only ...	28-9-26 28-9-26 30-9-26	9 9 6·5	24·5	Negative.
Rabbit No. 6 ...	Leaves and Pods	28-9-26	6·5	6·5	Dead 29-9-26.
Rabbit No. 10 ...	Pods and Bran	4-10-26	0·6	0·6	Dead 5-10-26.

Note.—The weights are expressed in grams. The housing arrangements for the sheep were very primitive. The sheep were confined in a small space without the possibility of exercise (said to make manifest toxic action of Gastrolobiums and Oxylobiums in general) throughout the feeding experiment.

(5) *Symptoms.*—No symptoms were seen, though the attitudes in which rabbits 5, 6, and 10 were found after death, and appearance of cages were unmistakable evidence that the animals had been affected with violent convulsions prior to death.

(6) *Post Mortem appearances.*—Injection of subcutaneous vessels and of mesentery and intestines.

Liver—Marked congestion, and microscopically congestion, hæmorrhage, cloudy swelling, and early fatty changes.

Kidneys—Congestion of cortex and medulla, confirmed by microscopic examination, which also revealed hæmorrhages.

Lungs—Bright red in colour.

(7) *Conclusions*—

1. The toxicity of freshly obtained seedlings, suckers and early fruiting plants of *G. bidens* for sheep and rabbits has been tested.

2. Though feed was eaten fairly readily negative results have been obtained with the exception of rabbits receiving fruit pods.

3. The results obtained would appear to indicate that either—(a) The plant is not so highly toxic as reported ; or (b) The toxic properties are lost very soon after picking ; or (c) In sheep, exercise is an important factor in production of fatal results following the ingestion of *G. bidens.*

4. The fruiting plant is much more highly toxic than seedling or sucker stages.

Experiment No. 2 :

(1) Locality specimens—Latham.

(2) Nature specimens—Fresh green plants bearing fully grown unripe fruit.

(3) Date—Collected 13-10-26 ; received 16-10-26.

(4) *Details.*—Two rabbits used as controls in an experiment detailed later, succumbed to the effects of eating fruit pods. Rabbit 13 ate two grams of fruit pods on 18-10-26 and died the following day. Rabbit 21 ate three grams of fruit pods on 21-10-26 and was found dead on 22-10-26.

(5) *Symptoms.*—Rabbit 13 at 8·45 a.m. was found to be dull and refused to move. Two minutes later animal was affected with violent convulsions which lasted for a short period and were followed by decubitis, air hunger, and death all within ten minutes of first observing it.

Post mortem as in Experiment No. 1.

(6) *Conclusions*—

1. The ingestion of less than five grams of fruit pods by rabbits is followed by death.

2. Symptoms, as also indicated in Experiment No. 1, shown by rabbits, result from great nervous stimulation.

Gastrolobium bilobum, R. Br. "Heart Leaf Poison."

History.—"Toxicity is greatest during flowering and seedling stages and after rains."

Symptoms said to be drowsiness, motor paralysis, etc., different from those produced by most other Gastrolobiums.

Experiment No. 1 :

(1) Locality specimens—Albany.

(2) Nature specimens—Fresh portions of green plant bearing ripe seeds.

(3) Date collected 26-1-26 ; received 28-1-26.

(4) *Details.*—Guinea pig No. 1 was found dead on 29-1-26, having eaten 0·08 grams of seeds fed on 28-1-26. Guinea pig No. 2 ate 7·25 grams of leaves in two days without showing any symptoms. Animal subsequently showed symptoms after eating 0·1 grams of seeds, and then ate very small amounts of feeds containing seeds, consuming only 0·04 grams of seeds in two days. Symptoms gradually diminished, guinea-pig apparently

Experiment :

(1) Source specimens.—L. W. Phillips, M.Sc.

(2) Nature specimens.—(a) Dry flowers and buds ; (b) Dry shoots from flowering plant.

(3) Date.—Received 21–10–26 ; tested 21–10–26.

(4) *Results.*—Rabbit No. 1 was found dead 22 hours after being fed with (a), having eaten 1·0 gram of flowers. Rabbit No. 2 died approximately 24 hours after being fed with (b), 1·5 grams of shoots having been eaten.

(5) *Symptoms.*—Rabbit No. 1 apparently was affected with violent convulsions prior to death. Twenty-two hours after being fed Rabbit No. 2 was noticed to be dull. External stimuli elicited an attack of convulsions lasting for a short time, after which the animal appeared moribund, heart action almost imperceptible. Shortly afterwards condition was much improved though animal showed signs of nervous excitement. Half an hour afterwards the rabbit died after a similar convulsive attack.

(6) *Post mortem.*—Congestion particularly of liver and kidneys.

(7) *Conclusions—*

1. Dried flowers, buds and shoots of *G. calycinum* are toxic for rabbits in small quantities.

2. The effects produced appear to be due to profound nervous stimulation.

Gastrolobium crassifolum, Benth. "Narrow Leaf Poison."

History.—Said to be "dangerous at all seasons, but more especially so when flowering or seeding, or when producing young shoots after a fire."

(1) Locality specimens.—Northam.

(2) Nature specimens.—Flowering plant, leaves appear old and somewhat dried ; no flowers included in samples for testing.

(3) Date.—Received ? ; tested 16–5–27.

(4) *Details.*—A guinea-pig ate 15 grams of plant within 41 hours without showing symptoms but was found dead on third day.

(5) *Post mortem.*—Liver congested and fatty. Kidneys showed parenchymatous nephritis.

(6) *Conclusion.*—Fifteen grams of leaves of *G. crassifolium*, when plant was in flowering stage, were found to be toxic for a guinea pig

Gastrolobium densifolium, Gardner.

History.—New species, suspected of being toxic for stock.

Experiment :

(1) Locality specimens.—Dudinin.

(2) Nature specimens.—Fresh flowering plant.

(3) Date.—Received and tested 23–10–26.

(4) *Details.*—Guinea pig No. 1 ate 12 grams minced plant, including flowers, in four days ; showing symptoms on fourth day when the experiment was discontinued because of lack of further material. The animal had recovered on the sixth day. Guinea pig No. 2 ate 7·0 grams of minced plant in three days and was found dead on fourth day.

(5) *Symptoms.*—Anorexia, erratic movements, intermittent attacks of muscular tremors and dullness.

(6) *Post mortem.*—(G.P. No. 2) Congestion notably of liver and kidneys and lungs ; microscopically congestion and hæmorrhage.

(7) *Conclusion.*—The results obtained would confirm field evidence of toxicity, flowering plant being toxic for guinea pigs.

normal on the eighth day after commencement of feeding test. Guinea pig No. 3 showed symptoms after eating 0·22 grams seed pods and was killed 10 hours after symptoms first noticed.

(5) *Symptoms*—Guinea-pigs 2 and 3 showed a similar semi-comatose condition with intermittent muscular tremors and difficulty in moving. Guinea pig No. 2 would persist in pushing its head up into a corner of the cage and if moved would eventually return to this position.

(6) *Post mortem*—Macroscopically and microscopically no marked pathological changes. The congestion of the liver and kidneys so typical of poisoning with other gastrolobiums was entirely absent.

Experiment No. 2 :

(1) Locality specimens—Same as Experiment No. 1.

(2) Nature specimens—Seeds only used.

(3) Date—Same as Experiment No. 1.

(4) *Details.*—The animals referred to were used as controls of toxicity in an experiment on 9–3–27 detailed later. Guinea pigs Nos. 1, 2, and 4 showed symptoms within 18 hours of eating respectively 0·14, 0·07, 0·05 grams of seeds. Nos. 1 and 2 succumbed ; No. 4 recovered.

(5) *Symptoms.*—Dullness, erratic movements, followed by coma, and in Nos. 1 and 2 obvious loss of control of muscles, particularly of hind limbs.

General Conclusions—

1. Heart-leaf seeds, even when over 12 months old, are highly toxic for guinea pigs.

2. Symptoms are characteristically those of depression and motor paralysis, as recorded, in contradistinction to usual Gastrolobium convulsive syndrome.

3. Post mortem lesions are very indefinite in contradistinction to the definite congestive changes which are a feature of the action of most Gastrolobiums.

Gastrolobium callistachys, Meissn. "Rock Poison."

History.—This plant is known to be toxic ; but here our information ends.

Experiment :

(1) Source specimens—L. W. Phillips, M.Sc.

(2) Nature specimens—Jar containing green leaves commencing to dry, labelled " Reputed highly toxic. No alkaloid present."

(3) Date—Labelled 23–6–27 ; tested 4–7–27.

(4) *Details.*—The total sample of 5·5 grams was fed to a guinea pig. Symptoms were apparent less than five hours after feeding, 1·3 grams having been eaten up till that time, when feed was removed.

(5) *Symptoms.*—Dullness, tonic muscular spasms.

(6) *Post mortem.*—Subcutaneous vessels injected, kidneys congested.

(7) *Conclusion.*—The leaves of *G. callistachys* would appear to be very highly toxic even some days after picking. This is contrary to the usual results obtained with W.A. poison plants.

Gastrolobium calycinum, Benth. "York-Road Poison."

History.—This is one of the best known and most dangerous of the W.A. poison plants. It is most toxic in the flowering and fruiting stages. Mann and Ince isolated an alkaloid " Cygnine " from this species.

Gastrolobium oxylobioides, Benth. "Champion Bay Poison."

History.—"The period of maximum virulence are the seedling, flower, and fruiting stages. Affected animals die in convulsions."

(1) Source specimens.—Obtained from Economic Botanist.

(2) Nature specimens.—Seeds.

(3) Date.—Collected (a) December, 1924 and (b) 5–1–17; tested (a) 2–2–26, and (b) 22–2–26.

(4) *Details.*—A guinea pig ate 0·05 grams seeds (a) in 18 hours with fatal results. A rabbit ate approximately 1·0 grams of seed (b) in three days without showing symptoms.

(5) *Post mortem.*—(Guinea pig). General congestion. Microscopically liver showed congestion and cloudy swelling, kidneys acute parenchymatous nephritis, lung congestion.

(6) *Conclusion.*—Seeds of this plant would appear to be highly toxic even about 12 months after collection, whereas seeds 10 years old would appear to have largely if not entirely lost their toxicity.

Section B.—Toxicity Experiments—Negative Results.

In very many instances negative results have been obtained in feeding tests with plants known to be poisonous. In most instances the stage of growth submitted has probably been responsible for the negative results obtained. Usually requests for further specimens in the flowering or fruiting stages, the stages most likely to give positive results, have met with a negative response from stock owners.

Euphorbia eremophila (fruiting stage), *E. drummondii* (fruiting stage), *Gastrolobium brownii* (flowering stage), *G. microcarpum* (flowering stage), *G. parvifolium* (leaves), *G. velutinum* (flowering stage) and many other species, some of which were unidentifiable specifically, have been tested with negative results.

Gastrolobium villosum, Benth. "Crinkly Leaf Poison."

History.—Known to be very toxic when flowering and fruiting.

At the request of a stock-owner I undertook experiments to determine whether seedlings, and adult non-flowering non-seeding plants were likely to be dangerous to stock.

Experiment:

(1) Locality specimens.—Mooliabeenee.

(2) Nature specimens.—Fresh adult green plants and seedlings.

(3) Date.—Received adult plant, 24–1–27; seedlings, 7–2–27. Tested adult plant 24–1–27; seedlings 7–2–27.

(4) *Result.*—Two rabbits each ate 20 grams of *G. villosum* leaves within 40 hours; three rabbits ate respectively 51, 87 and 100 grams of seedlings in three days, for first one and seven days for last two. In no case was any detrimental effect noticed.

Note.—Other tests have been done at different times with green leaves from grown plants always with negative results.

(5) *Conclusions.*—Neither leaves of non-flowering, non-fruiting plants, nor seedlings of *G. villosum* have been found to be toxic for laboratory animals. It would appear, and field evidence supports this, that *G. villosum* is probably only poisonous for stock when flowering or fruiting, unless, possibly, when eaten in large quantities at other periods.

Isotropis striata and Isotropis juncea. "Lamb Poisons."

History.—"Lamb Poisons are said to be dangerous to lambs, and to some extent to sheep also, but apparently not to other stock." There is no positive evidence of their toxicity except that lamb mortalities sometime

synchronise with the appearances of these plants and particularly the flowering plants. (The lamb mortality also synchronises with the period of the year when deaths may be expected from the Braxy-like Disease.)

Experiments :

Several feeding experiments with *I. striata* in the flowering stage (1925 and 1926), in which the plant formed the sole diet of guinea pigs and rabbits for some days, have all been attended with negative results, the plants being eaten with avidity. Filmer has also tested the plant with negative results.

One feeding test was done with *I. juncea*, also with negative results.

Conclusion.—Isotropis striata does not appear to be toxic for laboratory animals.

General Conclusions from Feeding Tests with Plants of the Genera Gastrolobium and Oxylobium.

1. The results obtained from feeding tests, with laboratory animals, with plants of the genera *Gastrolobium* and *Oxylobium* would tend to substantiate statements (mainly founded on field evidence) already made, viz.—

(1) The toxic properties of the plants vary considerably with the stages of growth. The flowering or fruiting plant is the most dangerous, the flowers and fruit themselves being the most toxic parts of the plant.

(2) *Symptoms.*—The separation of the plants contained in the genera into two groups, Group No. 1 containing the great majority of the plants in which the symptoms induced are those of nervous stimulation (York road, Box, etc.) and Group 2 in which nervous depression is the outstanding feature, (Heart leaf) would appear to have foundation. This differentiation would also appear to be borne out by the different pathological changes induced, congestion particularly of liver and kidney being characteristic of first group. In cases of poisoning by plants of the second group the pathological changes are indefinite.

2. Seeds of species tested have been found to be highly and constantly toxic for laboratory animals and apparently retain their toxicity for a considerable period, certainly in some cases for more than twelve months.

3. In view of this fact it would appear that the seeds are the most favourable, in fact the only suitable, part of the plant for chemical investigation.

4. Leaves of the plant, apart from seedlings which have seldom been available for test, have only very infrequently been found to be highly, if at all, toxic for laboratory animals (*G. callistachys* is a notable exception). It would appear that large quantities of leaves, except during flowering or fruiting periods, must be ingested before any toxic effect is manifested (symptoms were produced in a sheep after relatively large quantities of Box leaves were eaten) ; or that possibly toxic principles occurring in the leaves are unstable and disappear very soon after picking.

5. The great similarity in symptoms and post mortem appearances shown by laboratory animals, as a result of ingestion of species of Gastrolobiums and Oxylobiums tested, would indicate a similarity of type or identity of the toxic principles contained in the majority. The one probable exception is *G. bilobum.*

6. Two species, namely *Gastrolobium densifolium* (a plant not previously known), and *Oxylobium tetragonophyllum*, not prior to these experiments, classified as a " poison plant " have been found to be toxic for laboratory animals. In both cases the result substantiates field evidence of their toxicity.

SECTION C.—EXPERIMENTS TO DETERMINE ACTION OF ANTIDOTES, RECOMMENDED, ON TOXIC PROPERTIES OF W.A. POISON PLANTS.

1. Origin of Experiments :

Potassium permanganate and " Poison Plant Antidote Tablets" (Mann's formula) were originally recommended by E. A. Mann as antidotes for poisoning with *Gastrolobium calycinum*, though considered to be probably effective for cases of poisoning with other Gastrolobiums and Oxylobiums.

Doubt has been expressed from time to time as to the efficiency of these antidotes, notably recently by a correspondent from Latham, who furnished me with samples of *G. bidens*, the subject of remarks in the first section of this paper (*vide* Section A of this paper). Hence experiments were initiated with this plant, with the object of testing action of antidotes on the toxic principles contained in it.

2. Technique :

In the first experiments four groups of animals were used. *Group No.* 1 consisted of the test group, the animals receiving a toxic dose of, usually, fruits soaked for about four hours in a 1% potassium permanganate solution—the solution being then filtered off through linen cloth and the residue well washed with tap water before being fed. *Group No.* 2 consisted of controls for water solubility of toxic principles, the animals of this group receiving feed as in first group treated with tap water instead of potassium permanganate solution. *Group No.* 3 was used as a control of toxicity, these animals receiving identical doses of plant not submitted to any treatment (except division) prior to feeding. A *fourth Group* was used to control possibility of potassium permanganate being retained in sufficient amounts to be toxic. Grass soaked for four hours in 1% potassium permanganate aqueous solution, and washed, was fed to these animals.

The first three groups received the plant well mixed with 15 grams of bran and water, as in toxicity experiments. All animals were fed at the same time and were, of course, kept in different cages. The animals of a given experiment were selected so as to be of fairly even weight.

In the experiments with *G. bidens* it was found that the only animals dying were those in Group 3, *i.e.* those receiving untreated plant. The conclusion then arrived at was that either the toxic principles were destroyed by, or were soluble in tap water. Lengthy experiments were undertaken to prove this but results obtained were somewhat irregular and owing to supply of rabbits giving out experiments with this plant were discontinued.

Definite results were, however, obtained with *O. parviflorum*, *G. bilobum* and *G. calycinum*, the technique being modified in the later experiments. Here as detailed the fluids in which portions of the plant were treated were fed with the plants.

3. Experiments with O. parviflorum.—" Box Poison."

For details of source of plant specimens, etc. [*vide* Section A, *O. parviflorum* Exp. No. 3.]

Experiment No. 1 :

(1) *Purpose.*—To determine action of potassium permanganate on toxic properties of seeds.

(2) *Details*—

(a) *Test Animal.*—Rabbit 30 received crushed seeds 0·5 grams soaked for four hours in excess of 1% aqueous potassium permanganate solution ; residue only, after filtering and washing, was fed.

(b) *Control Water Action.*—Rabbit 31 received crushed seeds 0·5 grams as in (a), except that tap water was used instead of potassium permanganate 1% solution.

(c) *Control Toxicity.*—Rabbit 32 received crushed seeds 0·5 grams untreated (except pulverised).

(d) *Control Potassium Permanganate.*—Rabbit 33 received 10 grams grass soaked for four hours in 1% potassium permanganate solution and then washed.

The experiment was started on 1/2/27.

(3) *Results*—

On 2/2/27 Rabbit No. 32 (Control Toxicity) was found dead having, eaten approximately half of the seed (feed had been spilt during convulsions of animal prior to death). The other animals had eaten all their respective feeds and showed no symptoms.

(4) *Conclusions*—

(a) The toxic principles of the seeds of *O. parviflorum* are destroyed by, or are soluble in water.

(b) Less than 0·5 grams untreated seeds were toxic for a rabbit.

(c) Further experiments are necessary in order to determine nature of the action of water on the toxic properties of seeds.

Experiment No. 2 :

(1) *Purpose.*—To determine action of both tap and distilled water on the toxic principles of the seeds of *O. parviflorum.*

(2) *Details*—(a) Group I., to test toxicity of seed residue after treating with tap water—Rabbits 34 and 35 each received 0·5 grams pulverised seeds previously soaked for four hours in 150 c.c. tap water at room temperature and washed well before being fed.

(b) Group 2, to test toxicity of tap water infusions—Rabbits 36 and 37 each received half of filtered fluid from (a), *viz.* 71 c.c. each.

(c) Group 3, to test toxicity of seed residue after treating with distilled water—Rabbits 38 and 39 each received 0·5 grams pulverised seeds previously soaked for four hours as in (a), using distilled water.

(d) Group 4, to test toxicity of distilled water infusion—Rabbits 40 and 41 received 76 c.c. each of filtered fluid from (c).

(e) Group 5, to control toxicity of untreated seeds—Rabbit 42 received 0·5 grams of untreated pulverised seed.

The experiment was commenced on 2/2/27.

(3) *Results*—3/2/27—

Group 1.—All feed eaten ; animals normal.

Group 2,—Feed partly eaten ; both animals dead.

Group 3,—Rabbit 38 died from other causes after leaving feed practically untouched.

Rabbit 39 : Feed all eaten ; animal normal.

Group 4.—Feed almost all eaten ; both animals dead.

Group 5.—Rabbit 42 dead ; 0·3 grams seeds eaten.

(4) *Conclusions.*—(a) The toxic principles of Box seeds are readily soluble in both tap water and distilled water.

(b) Aqueous infusions of seeds in either tap water or distilled water are highly toxic.

(c) The residue of powdered seeds after soaking for four hours in excess of either tap water or distilled water is apparently non-toxic (when given in small amounts much in excess of toxic dose of untreated seeds).

(d) In experiments to investigate the action of antidotes on toxic principles of *O. parviflorum* (and probably other plants) it will be necessary to feed the entire mixture of portions of plants, and fluids in which they are treated.

(N.B.—This practise was followed in all subsequent experiments.)

Experiments No. 3:

(1) *Purpose.*—To determine action of potassium permanganate on the toxic property of seeds of *O. parviflorum.*

(2) *Details.*—(a) Group 1—Test animals.—Guinea pigs 37 and 38, each received 0·25 grams pulverised seeds soaked for 4½ hours in 5 c.c. of a 1% solution of potassium permanganate in distilled water.

(b) Group 2—Controls Toxicity Potassium permanganate.—Guinea pigs 39 and 40 each received 5 c.c. potassium permanganate solution as above in ordinary feed.

(c) Group 3—Control Toxicity.—Guinea pig 41 received 0·25 grams of untreated seeds.

(N.B.—Guinea pigs 37–40 inclusive were all fed with approximately three-fourths of a grain of potassium permanganate each.)

The experiment was commenced on 3/2/27.

(3) *Results*—4/2/27—

Group 1.—Guinea pig 38 dead ; 0·19 grams seed eaten.
Guinea pig 37 died ; 0·05 grams seed eaten.

Group 2.—No symptoms ; both animals eaten three-fifths of their feed.

Group 3.—Guinea pig 41 dead ; 0·07 grams seeds eaten.

(4) *Conclusions.*—(a) The treatment of 0·25 grams pulverised seeds of *O. parviflorum* with 5 c.c. of a 1% solution of potassium permanganate in distilled water does not appear to make any material difference to their toxicity.

(b) The experiments should be repeated using larger quantities of potassium permanganate. The effect of potassium permanganate in acid solution should also be tried.

N.B.—These three experiments may be taken as a type of the further experiments which I do not propose to give in detail.

Experiment No. 4:

A prototype of Experiment No. 3, using 20 c.c. of potassium permanganate solution instead of 5 c.c.

(1) *Results.*—As for Experiment 3.

(2) *Conclusions*—Potassium permanganate in neutral solution does not appear to have any detoxicant action on the toxic principles contained in seeds of *O. parviflorum*, as demonstrated by controlled experiments. Even when pulverised seeds are treated with an equal mass of potassium permanganate in neutral solution the toxicity of the seeds is not modified after 4½ hours soaking.

Experiment No. 5 :

A prototype of Experiments Nos. 3 and 4 except that each 0·25 grams of seed were soaked for 3½ hours in 60 c.c. tap water in which was previously dissolved 0·3 grams of " Poison Plant Antidote Tablets." These tablets were supplied by Felton, Grimwade & Bickford, and are made according to Mann's formula ; each tablet contains approximately 1·27 grams, and the dose recommended for sheep is one tablet. The results obtained were as in previous experiments ; 0·08 and 0·09 grams of pulverised seeds, treated with antidote, were found to be toxic for guinea pigs.

Experiment No. 6 :

A repetition of Experiment No. 5, with the difference that seeds were soaked for 4½ hours in antidote solution instead of for only 3½ hours.

The results obtained were identical with those obtained in Experiment No. 5, 0·1 grams treated seeds being found fatal for guinea pigs in this case.

Conclusions.—Experiments 5 and 6 show that " Poison Plant Antidote Tablets " (Mann's formula) have no detoxicant effect on the toxic principles contained in pulverised seeds of *O. parviflorum*, even when seeds are treated with a slight excess of tablet in solution.

N.B.—In these experiments the smallest quantity of untreated seeds proving fatal for guinea pigs was 0·09 grams. The smallest quantity of treated seeds was 0·05 grams.

4. **Experiments with Gastrolobium bilobum.—" Heart Leaf Poison."**

For details of source of plant specimens, etc. [*Vide* Section A., *G. bilobum*, Expt. No. 2].

The purpose of this experiment was as for *O. parviflorum* experiments 5 and 6 (*vide supra*). The technique used was identical.

Only one experiment was carried out with *G. bilobum*, using the same quantities of pulverised seeds and antidote (" Poison Plant Antidote Tablets ") as in the *O. parviflorum* experiments. The period of treatment of seeds with antidote solution was four hours. The experiment was commenced on 9/3/27. *The result obtained* was as for *O. parviflorum* experiments 5 and 6 : 0·14 and 0·07 grams of treated seeds of *G. bilobum* were found to be toxic for guinea pigs.

Conclusion.—" Poison Plant Antidote Tablets " (Mann's formula) have no detoxicant effect on the toxic principles of pulverised seeds of *G. bilobum*.

5. Experiments with Oxylobium tetragonophyllum :

For details of source of plant specimens, etc. [*Vide* Section A, this plant].

During my absence Filmer conducted an experiment to determine the effect of potassium permanganate on the toxic principles contained in this plant. He reports as follows :—" Wild rabbit weighing 1,077 grams :—6/8/26, 4 p.m., fed eight grams flowers and buds which had been soaked for five hours in a 1% aqueous solution of potassium permanganate, washed, ground and mixed with damp bran ; 7·30 p.m., found dead, rigor mortis had set in ; there were signs of struggling ; 4·0 grams of flowers and buds had been eaten."

Conclusion.—Toxicity of flowers and buds of *O. tetragonophyllum* was not removed by soaking in 1% aqueous solution of potassium permanganate for five hours and washing. It would further seem doubtful if potassium permanganate will prove effective as an antidote in cases of poisoning with this plant.

6. Experiments with Gastrolobium calycinum—"York Road Poison."

As already mentioned, it was for cases of poisoning of stock with this species that Mann originally recommended the potassium permanganate treatment. The grounds on which he based his recommendations are as follow :—

(1) The isolation of a toxic alkaloid cygnine from this plant which when injected subcutaneously in small doses produced symptoms (and death) in guinea pigs resembling those obtained when the plant was fed.

(2) *Chemical Test.*—"Theoretically, therefore, it is a case peculiarly suitable for the application of the permanganate treatment, and this has been confirmed by the following practical test made in the laboratory :—"Half a pound of the powdered York road plant was treated with slightly acid water in order to extract the alkaloid, and then to the mixture of extract and solid material was added 10 grains of permanganate of potash. This was instantly de-colourised, showing that it had oxidised some substance present, and when tested immediately after the extract gave no tests for alkaloid showing that the latter had been destroyed even in the presence of a large quantity of other organic matter."

(Quoted from Mann, Journal of Agriculture, W.A., Vol. XII., 1905, p. 560.)

A similar experiment was also done by Mann with Box Poison, with the same result—destruction of alkaloid.

(3) The results of treatment of stock in the field as reported by stock-owners and others. The instances quoted by Mann would tend to support the potassium permanganate treatment but the numbers of cases treated are small and the tests are uncontrolled, therefore inconclusive.

It was felt that experiments with York Road poison were required to complete the work in this section, but seeds of this plant had not been obtainable when wanted. However, thanks to the courtesy of Mr. Wickens, of this Department, supplies of young shoots have been available. The effect of antidote on those has been tried.

(4) *Experiments :*

(a) Source of material.—Mundaring.

(b) Nature of material.—fresh green suckers with young shoots.

(c) Date received.—29/7/27 ; tested 29/7/27 and 30/7/27.

(d) *Details.*—Two experiments were carried out identical with those previously described in this section, except that finely chopped young terminal shoots of suckers were used instead of seeds. In the first experiment the dose used was 3·0 grams and in the second experiment, 6·0 grams. The test animals received leaves soaked for five hours in the antidote tablet solution in the first experiment, 4¾ hours in the second. Guinea pigs were used as experimental subjects.

(5) *Results.*—The results obtained were similar to those with the other plants in this section.

In Experiment No. 1 both test animals succumbed, having eaten all feed. The guinea pig used as a control of toxicity ate all the feed and was very sick for two days, showing similar symptoms to the others, but recovered on the third day.

In Experiment No. 2 an identical result was obtained—the two test animals succumbed after eating 2·6 and 2·0 grams plant respectively ; the control of toxicity, considerably heavier than any of the others, ate 4·3 grams and was affected with acute symptoms, but subsequently recovered.

(6) *Conclusions.*—(a) Solutions containing five grains (0·3) of "Poison Plant Antidote Tablet" were found to have no appreciable detoxicant effect on the toxic properties of 45 grains, = 3 grams (in two cases) and 90 grains = 6 grams (in two cases) of finely divided shoots of *G. Calycinum* even when in intimate contact for approximately five hours. The toxicity was determined by feeding tests.

Mann, as quoted, states that 10 grains of potassium permanganate destroyed all traces of alkaloid contained in half a pound of leaves of *G. Calycinum.* The plant used by Mann was probably considerably less toxic than shoots used in my experiments, but the organic matter (which might oxidise the potassium permanganate) present in these tests is negligible when compared with that in Mann's experiment.

(b) It does not appear that "Poison Plant Antidote Tablets" (or potassium permanganate) are likely to be of value as antidotes in cases of poisoning with *G. Calycinum.*

GENERAL CONCLUSIONS—SECTION C.

1. The effect of the action of potassium permanganate on the toxic principles contained in plants representative of the genera *Gastrolobium* and *Oxylobium* has been tested as detailed above. The potassium permanganate has been used either in neutral solution or in acid solution in form of "Poison Plant Antidote Tablets" (Mann's formula).

2. It would appear that *in vitro* potassium permanganate has no detoxicant action on the toxic principles contained in the plants *Oxylobium parviflorum, Oxylobium tetragonophyllum, Gastrolobium bilobum* and *Gastrolobium calycinum.*

3. It does not appear probable that potassium permanganate will be of much value as an antidote in cases of poisoning with *O. parviflorum, O. tetragonophyllum, G. bilobum* and *G. Calycinum,* having failed in *in vitro* tests where every opportunity was given for its action to be manifested. On present evidence it appears that the recommendation of potassium permanganate, even in form of "Poison Plant Antidote Tablets," as an antidote in cases of poisoning of stock with plants of the genera *Oxylobium* and *Gastrolobium* is unwarranted.

4. The toxic principles contained in seeds of *O. parviflorum* have been shown to be very soluble in tap water and distilled water ; the same probably applies to *G. bidens* and possibly to other poisonous members of the genera *Oxylobium* and *Gastrolobium.*

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